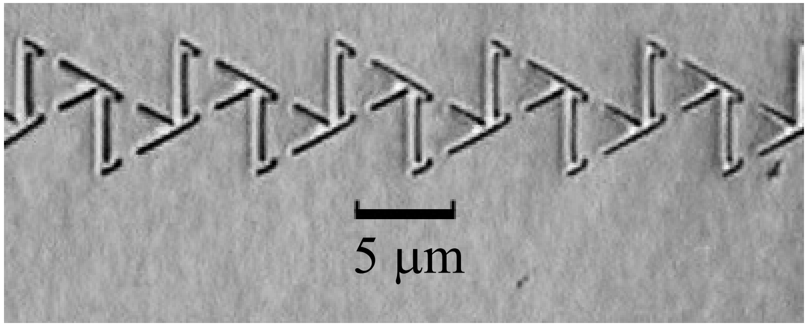
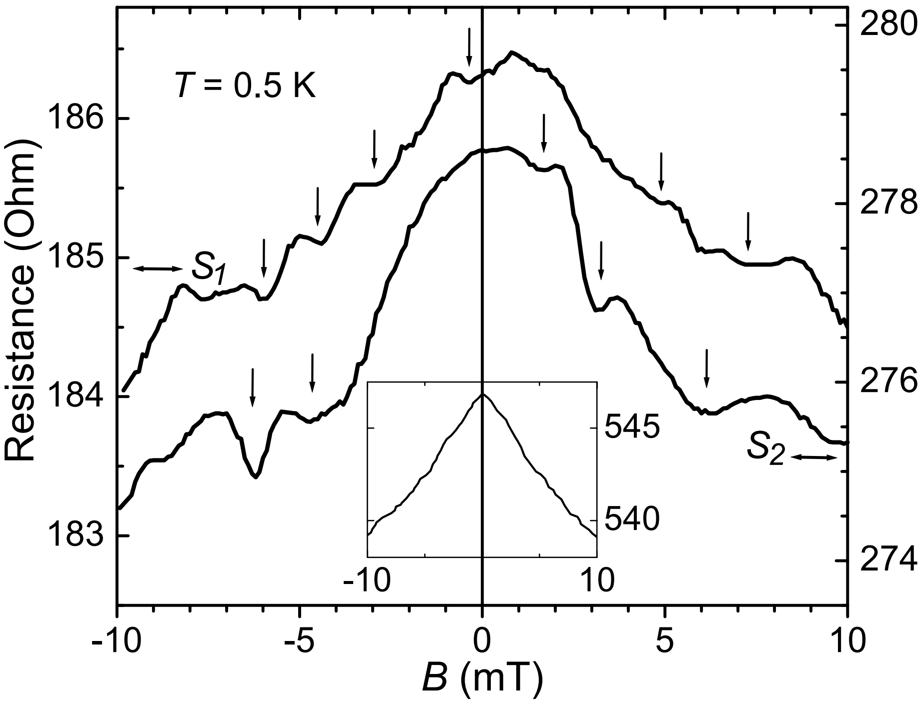
Mesoscopic spin-dependent transport in two-dimensional systems

Jean J. Heremans, Ohio University, DMR-0094055

Spin-dependent electron reflection: Present-day transistors are based on movement of charge. Future electronics may be based on a quantum property of the electron, spin. The study of spin-based electronics carries the name Spintronics. We have studied how the spin influences the way an electron bounces off a wall in nanoscale electronic devices. These reflection properties are important if the device sizes are very small, and may also be used to select one spin over another, important in spintronics. The system we study consists of an array of triangles, with entry and exit apertures (top figure). Electrons enter the triangles from above, and spin-dependent electron reflection occurs from the triangles' left walls. Measurements are shown in the lower figure. Arrows indicate spin-dependent features in the resistance versus magnetic field trace.



The samples are fabricated using high-resolution electron beam lithography on InSb/InAlSb heterostructures.



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Outreach:
We have established a *Cooperative Education Program* with a nearby two-year technical college (Hocking College). The technology involved in fabricating and measuring the spintronics devices presents an opportunity to the technical students, from the economically underdeveloped Appalachian region, to acquire skills the region presently does not offer. The students can utilize the skills and knowledge acquired in the cooperative education program to improve their participation in a high-technology area.

Education:
Undergraduate student A. McNamara, is adapting our atomic force microscope to nanolithography, to reach even smaller dimensions for our spintronics devices. Graduate student John Peters and post-doc Hong Chen contributed to this work.

Hocking College students R. J. Smith and M. P. Bratton with some equipment they designed and assembled under the Cooperative Education Program